

WHAT IS CLAIMED IS:

1 1. An airplane guidance method involving an inertial reference system and a
2 GPS landing system, the airplane guidance method comprising:
3 converting position coordinates of an aircraft from the inertial reference
4 system to runway, lateral, and vertical coordinates;
5 calibrating runway distance and lateral distance based on the converted
6 position coordinates from the inertial reference system using runway distance and lateral
7 distance from the GPS landing system with a third-order calibration filter when the
8 aircraft is below a first height above terrain;
9 calibrating vertical distance based on the converted position coordinates
10 from the inertial reference system using vertical distance from the GPS landing system
11 with a second-order calibration filter when the aircraft is below the first height above
12 terrain; and
13 using the calibrated runway, lateral, and vertical distances for deviation
14 computations when GPS signals are interrupted below a second height above terrain.

1 2. The method of claim 1, further comprising determining a reference
2 trajectory, the reference trajectory including horizontal and vertical positions, for the
3 inertial reference system computed with velocity from the inertial reference system and
4 initial position from the GPS landing system.

1 3. The method of claim 1, wherein the first height is 1500 feet.

1 4. The method of claim 1, wherein the third-order calibration filter converges
2 when an error signal is within 0.15m for 30 seconds.

1 5. The method of claim 1, wherein the second-order calibration filter
2 converges when an error signal is within 0.2m for 30 seconds.

1 6. The method of claim 1, further comprising generating airplane control
2 signals based on the deviation computations.

1 7. The method of claim 1, wherein the GPS landing system comprises a
2 ground station for generating differential global positioning system information.

1 8. The method of claim 1, wherein the velocity error state of the third-order
2 calibration filter is initialized by velocity difference between velocity measurements in
3 the GPS landing system and the inertial reference system.

1 9. The method of claim 1, further comprising buffering values from the GPS
2 landing system and the inertial reference system before processing to ensure data
3 integrity.

1 10. A method of deriving inertial-aided deviations for autoland systems during
2 GPS signal interruptions, the method comprising:
3 generating global positioning positions;
4 generating inertial reference system positions; and
5 generating calibrated positions based on the global positioning positions
6 and the inertial reference system positions using a third-order calibration filter and a
7 second-order calibration filter.

1 11. The method of claim 10, wherein the calibrated positions comprise
2 runway distance, lateral distance, and aircraft height.

1 12. The method of claim 10, wherein a velocity error state of the third-order
2 calibration filter is initialized by velocity difference between velocity measurements in a
3 GPS landing system and an inertial reference system.

1 13. The method of claim 10, further comprising providing airplane control
2 signals using deviation computations from the generated calibrated positions when the
3 calibration filters converge.

1 14. The method of claim 13, wherein the third-order calibration filter
2 converges when an error signal is within 0.15m for 30 seconds.

1 15. The method of claim 13, wherein the second-order calibration filter
2 converges when an error signal is within 0.2m for 30 seconds.

1 16. The method of claim 13, wherein the airplane control signals are provided
2 using deviation computation when GPS signals are interrupted.

3 17. The method of claim 16, wherein aircraft height is 200 feet or less.

1 18. A system for deriving inertial-aided deviations for autoland systems
2 during GPS signal interruptions, the system comprising:
3 a first component for generating global positioning positions;
4 a second component for generating inertial reference system positions;
5 a third component for generating calibrated positions based on the global
6 positioning positions and the inertial reference system positions using a third-order
7 calibration filter and a second-order calibration filter; and
8 a fourth component for providing airplane control signals using deviation
9 computations from the generated calibrated positions when the calibration filters
10 converge.

1 19. The system of claim 18, wherein the third-order calibration filter
2 converges when an error signal is within 0.15m for 30 seconds; and wherein the second-
3 order calibration filter converges when an error signal is within 0.2m for 30 seconds.

1 20. The system of claim 18, wherein the airplane control signals are provided
2 using deviation computation when GPS signals are interrupted.